

Weak-binding relation in the zero range limit

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The investigation of possible exotic internal structures of hadrons is an important subject in hadron physics. Recently, the weak-binding relation is shown to be useful to determine the compositeness X of near-threshold hadrons [1, 2]:

$$a_0 = R \left\{ \frac{2X}{1+X} + \mathcal{O}\left(\frac{R_{\text{typ}}}{R}\right) \right\}, \quad (1)$$

where a_0 is the scattering length, R is the radius of the eigenstate, and R_{typ} is the typical length scale of the interaction. Because the correction terms of the weak-binding relation is estimated by R_{typ} , it vanishes in the exact zero range limit $R_{\text{typ}} \rightarrow 0$. We show that there are exceptional cases which violate the relation (1), when the zero range limit is taken with a fine tuning of parameters. We propose a suitable modification of the correction term of the weak-binding relation, so that the relation is valid also in the zero range limit.

References

- [1] Y. Kamiya and T. Hyodo, Phys. Rev. C **93**, 035203 (2016)
- [2] Y. Kamiya and T. Hyodo, PTEP **2017**, 023D02 (2017).